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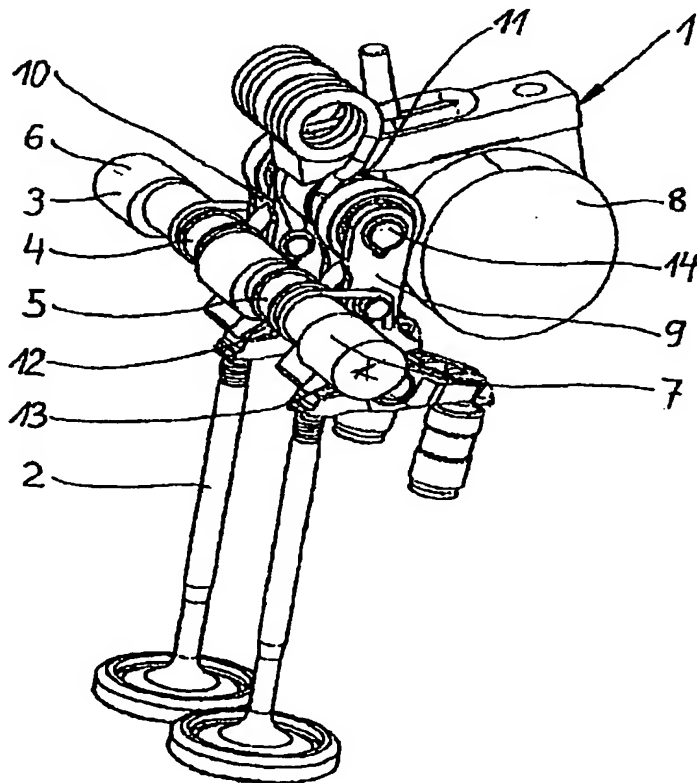
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[Continued on next page]

(54) Title: VARIABLE VALVE LIFT DEVICE FOR THE LIFT ADJUSTMENT OF GAS-EXCHANGE VALVES OF AN INTERNAL COMBUSTION ENGINE



(57) Abstract: In order to produce a variable valve lift device for the lift adjustment of the gas-exchange valves of an internal combustion engine, by means of which with adjustment forces and holding forces, independently from whether said holding forces and adjustment forces are applied mechanically, hydraulically or electrically, with an adjustment of the valve lift being as cost-effective as possible, and with maximum accuracy of the adjustment or control of the valve lift to be taken between the individual cylinders of a multi-cylinder internal combustion engine, and, moreover, the adjustment possibility of the valve lift of the valves of an internal combustion engine with several cylinders is obtained within smallest tolerances, it is suggested that a valve lift device (1) has a rotatable eccentric shaft (3), which consists of several eccentrics (4, 5) and whereby all possible contours of the eccentrics (4, 5) are positioned within a circle, which is formed by means of the external diameters of a bearing (6, 7) of the eccentric shaft (3).



(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,

GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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INTERNATIONAL SEARCH REPORT

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PCT/EP2004/003264

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F01L13/00 F01L1/344 F01L1/46 F01L1/18 F01L1/14
F01L1/24 F01L1/053

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 373 818 A (UNGER HARALD) 20 December 1994 (1994-12-20) the whole document	1-3,7,8, 10-12, 14,20, 21,97
Y	US 5 601 056 A (KUHN PETER ET AL) 11 February 1997 (1997-02-11) claims; figure 3	1-3,7,8, 10-12, 14,20, 21,97
A	US 6 098 581 A (HIERETH ALEXANDER ET AL) 8 August 2000 (2000-08-08) the whole document	1,4-6
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/003264

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 0081, no. 74 (M-316), 10 August 1984 (1984-08-10) & JP 59 068508 A (HONDA GIKEN KOGYO KK), 18 April 1984 (1984-04-18) abstract; figures	1-3
A	US 5 215 048 A (KAISER HANS-JUERGEN ET AL) 1 June 1993 (1993-06-01) abstract; figures	14, 18
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A, P	DE 101 40 635 A (FLIERL RUDOLF) 24 April 2003 (2003-04-24) the whole document	76-81, 83-88, 97, 100
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2004/003264

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,
no additional fees are to be refunded.

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22,97

Variable valve lift device comprising a rotatable eccentric shaft, with the contours of the eccentric being positioned within a circle formed by the external diameter of a bearing of the eccentric shaft

2. claims: 23-39,98

actuator technology

3. claims: 40-64,99

device for the variable valve control or adjustment with a camshaft adjustment device

4. claims: 65-75

device for the variable valve lift adjustment comprising a multi-part eccentric shaft for the adjustment of the valve lift

5. claims: 76-96,100

variable valve lift control system for a combustion engine with underneath camshaft

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/003264

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